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Incorporation of Duluth Complex Maps into GIS Platform

The goal of my research with Dr. Jim Miller was to compile existing mapping and geologic data into a digital geologic map and database for the Duluth Complex. To this end, I created a Geographic Information System (GIS) platform that at the time of this report included over 1,000 plotted outcrops in the Snowbank 7.5' quadrangle. This northwestern part of the Duluth Complex is located in the Boundary Water Canoe Area Wilderness (BWCAW) and is the site of Dr. Miller's 1981 mapping of the Lake One - Lake Four chain. My research was originally going to include both Dr. Miller and Dr. William Phinney's data for this area, but due to time constraints only Dr. Miller's data has been incorporated into GIS thus far.

To efficiently draw the numerous outcrops into GIS, Dr. Miller and I devised a method for inserting aerial photos as a base layer under our area map. The original aerial photos were scanned and then uploaded into GIS. By overlaying the area map over the photos, I was able to accurately trace the outcrops into GIS. Figure 1 shows an example of what this process looked like. Not only were over 1,000 outcrops digitized onto a GIS map, but a table of attributes was added for every outcrop Dr. Miller cataloged. These attributes include the outcrop number, the date they were originally studied, the major and minor lithology of the rock and a short description for each. An example of this table is shown in Figure 2.

The greatest benefit of this research is the compilation of data we made available to anyone researching the Duluth Complex. In time, this GIS platform will be made available on

the Precambrian Research Center website. This will allow future researchers and geologists access to the maps and data which have been inaccessible to the public for decades. This fact alone made my research a very rewarding experience.

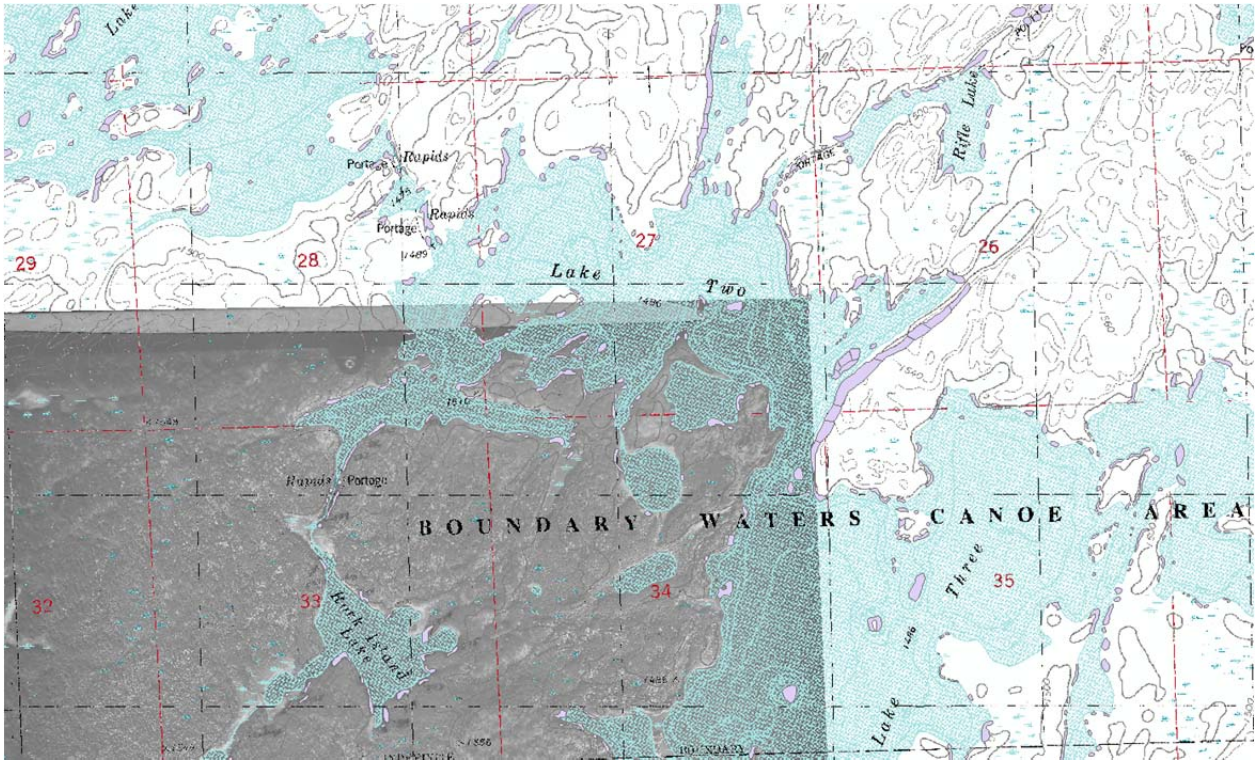

Fig 1. GIS map showing areas of the BWCAW. Aerial photo as a base layer in bottom left. Light gray outcrops around Lake Two were digitized from Dr. Miller's 1981 mapping data (Miller 1986).

FID	Shape *	ID	STATION	DATE	GEO	MAJOR_LITH	MINOR_LITH	DESCRIPTIO
46	Polygon	0	298	71681	JDM	Troctolitic Anorthosite	Olivine	Foliated, layered olivine
45	Polygon	0	299	71681	JDM	Troctolitic Anorthosite	Olivine	Fine grained, poor exposure
44	Polygon	0	300	71681	JDM	Anorthosite	Olivine	Good foliation, olivine oikocrysts up to 7cm, oikocrysts show layering
38	Polygon	0	301	71681	JDM	Troctolite	Augite, FeO	Med-grained, poor foliation
53	Polygon	0	302	71681	JDM	Troctolite	Olivine	Med- to fine-grained, good foliation, olivine <45%
54	Polygon	0	304	71681	JDM	Troctolite/Anorthosite	Olivine, Augite, FeO	Gabbroic anorthosite, foliated, troctolite finer grained
57	Polygon	0	305	71681	JDM	Troctolite	Augite, FeO	Moderate foliation, megacrysts of plagioclase, oikocrysts of augite
42	Polygon	0	306	71781	JDM	Troctolitic Anorthosite	Olivine	Foliated
197	Polygon	0	307	71781	JDM	Anorthosite	Olivine, Augite, FeO	Olivine oikocrysts elongate in foliation, average 6cm X 3cm
43	Polygon	0	308	71881	JDM	Troctolitic Anorthosite	Olivine, Augite, FeO	Med- to coarse-grained, good foliation, oikocrysts, troctolitic dike
61	Polygon	0	309	71881	JDM	Troctolitic Anorthosite		Well foliated, poor exposure
62	Polygon	0	310	71881	JDM	Troctolitic Anorthosite	Augite, FeO	Med- to coarse-grained, strong foliation
63	Polygon	0	311	71881	JDM	Troctolitic Anorthosite	Augite, FeO	Augite oikocrysts, poor foliation
65	Polygon	0	312	71881	JDM	Troctolitic Anorthosite		Good foliation, weathered
66	Polygon	0	313	71881	JDM	Troctolitic Anorthosite	Olivine	Med- to coarse-grained, ranges from troctolitic anorthosite to anorthosite, olivine oikocrysts, foliated

Fig 2. Table of attributes associated with outcrops in GIS. Each outcrop can be references by major/minor lithology and physical description.

Not all of my educational objectives were met during my research. As I stated above, the GIS platform I created was going to contain both Dr. Miller and Dr. Phinney's data. Unfortunately, this project was far more time consuming than we originally estimated.

Ultimately only Dr. Miller's data was digitized and not all of the features we wanted to incorporate into the platform were created. However, this leaves the door open for future work done by another eager undergraduate. Adding all of the structural data and color coding the outcrops based on major lithology would make the data even more useful. Even though I didn't reach all my goals, I gained a working knowledge on the use of GIS and learned more about the Duluth Complex.

Overall, my UROP experience was invaluable in expanding my knowledge in the field of geology. The project was hard work, but truly rewarding. It gave me an appreciation for good field methods and data collection. I also utilized GIS for the first time and learned basic commands for manipulating maps and data tables. If there is one thing I wish I had done better, it would have been estimating the time line for finishing my research. On the school's end, it was a very streamlined process and expectations were clearly outlined. I hope I will have the opportunity to participate in another UROP in the future.

References

Miller, J.D., Jr., 1986, The geology and petrology of anorthositic rocks in the Duluth Complex, Snowbank Lake quadrangle, northeastern Minnesota. unpublished Ph.D. dissertation, University of Minnesota, Minneapolis, 280 p.

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Phinney, W.C., 1972. Northwestern part of Duluth Complex. In: Sims, P.K. & Morey, G.B. (eds.) Geology of Minnesota -A centennial volume. Minnesota Geological Survey, p. 335-345